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EP 0808431 A1 US 5449322 A

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(54) Abstract Title
A device for isolating fluctuations in the drive torque of a rotary drive shaft

(57) A device for isolating fluctuations in the drive torque of a rotary drive shaft comprises a hub member 2 for connection to a drive shaft (not illustrated), a second pulley member 3 for connection to a driven member (not illustrated) and a resilient elastomeric member 4 interposed between the hub and pulley members 2, 3. The hub member 2 is connected to an inertia member 20 via a second resilient member 25. A radial clearance 27a, 27b defined between at least part of the pulley 3 and the inertia member 20 receives a bearing 29 that has a first portion that serves as a radial journal bearing in the clearance 27a; and a second portion that serves as an axial thrust bearing in the clearance 27b.

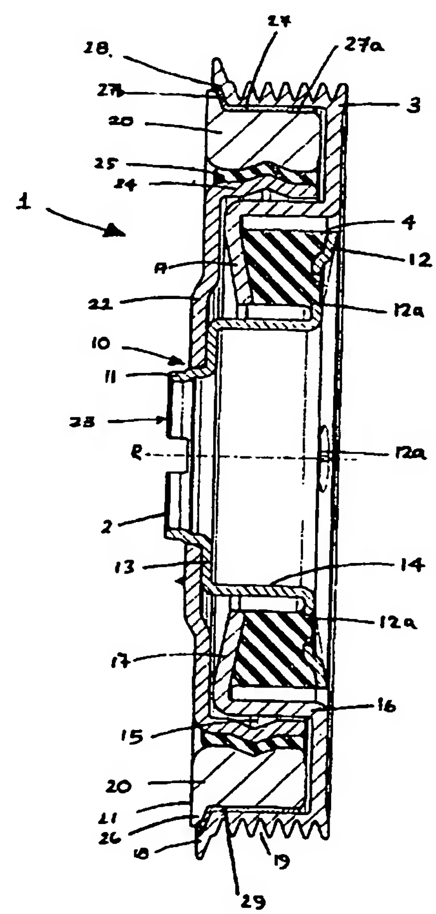

FIG. 1

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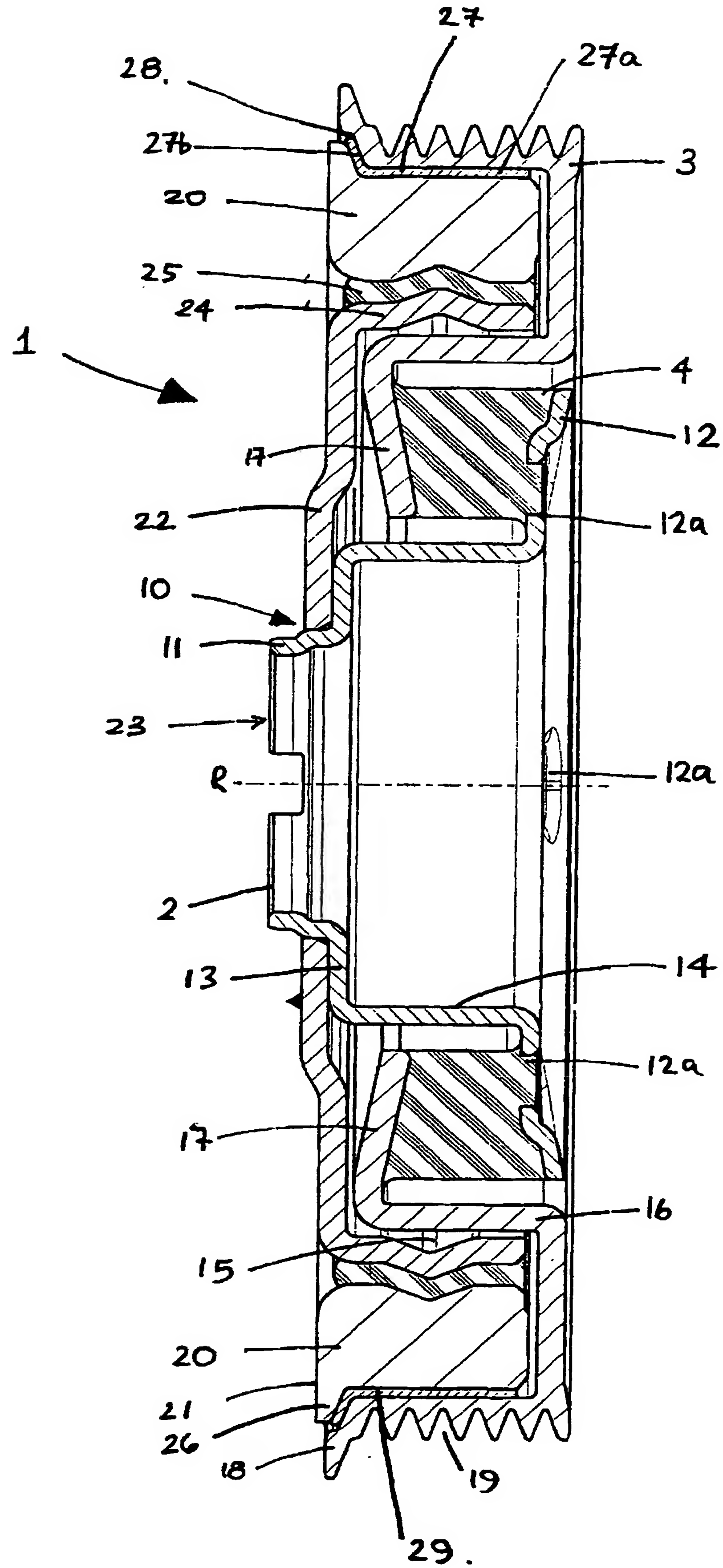
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27b
3
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FIG. 1

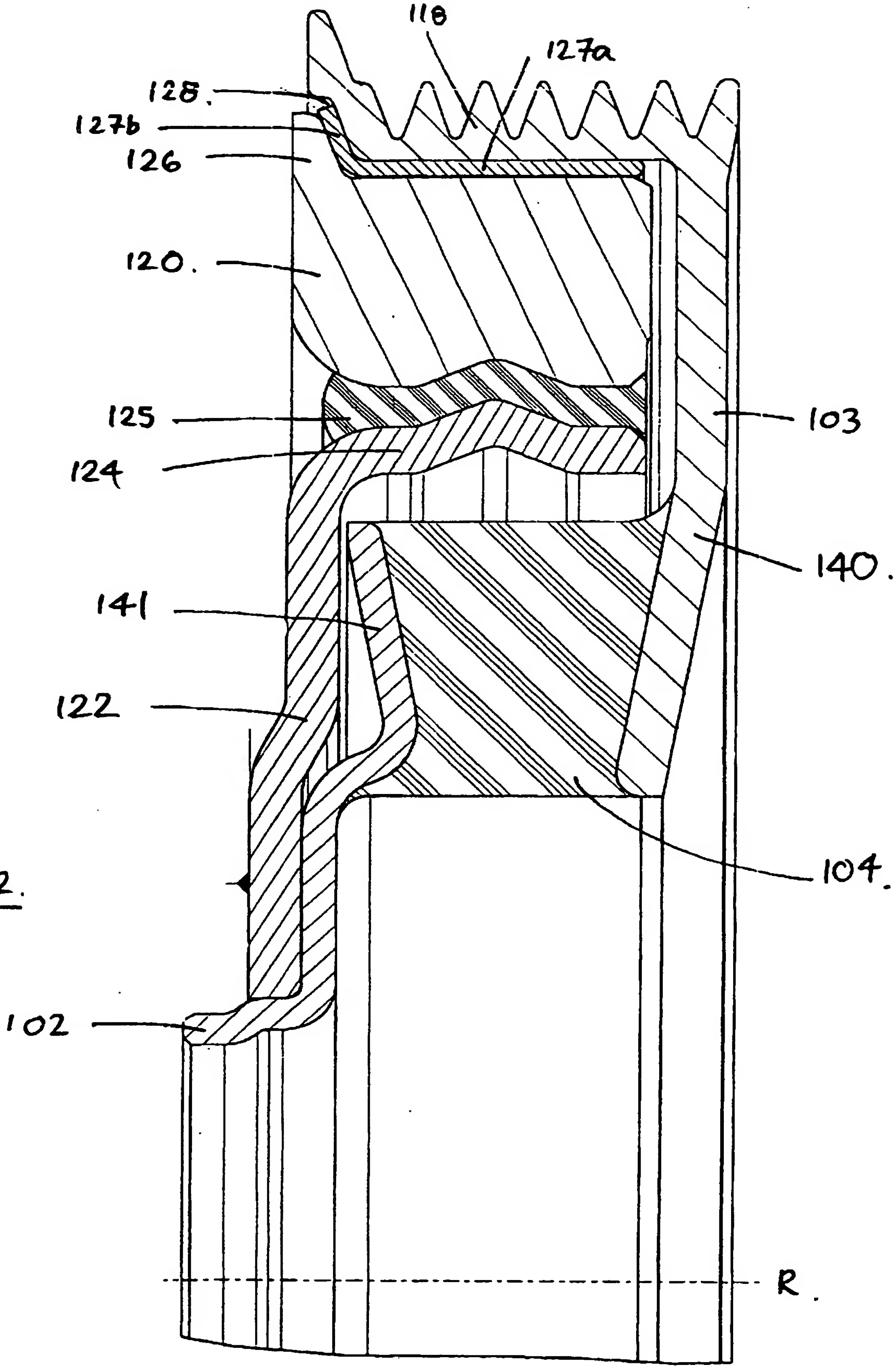

FIG. 2.

A DEVICE FOR ISOLATING TORQUE FLUCTUATIONS

The present invention relates to a device for isolating fluctuations in torque and more particularly to such a device for isolating fluctuations in the drive torque of a rotary drive shaft.

Such devices are well known and are often mounted on the crankshaft of an internal combustion engine of a motor vehicle so that they can drive a driven auxiliary component such as an alternator, a fan or other piece of equipment. In internal combustion engines the torque applied to the crankshaft fluctuates as a result of, for example, the periodic firing of the engine pistons that drive the crankshaft and the changes in the speed of rotation of the crankshaft. These torque fluctuations and associated noise may undesirably be transferred to the auxiliary equipment and affect their operation. Devices for isolating torque fluctuations are often fitted with a torsional vibration damper in the form of an annular inertia member mounted on elastomeric material.

One example of a device of this kind is disclosed in our European Patent No. EP808431. This drive device comprises a primary element connected to the drive shaft and a secondary element having a contoured pulley rim around which a V-belt drive is trained. The belt transmits power from the drive shaft to a driven component. The primary and secondary elements are interconnected by a torsionally flexible elastic ring which is loaded in shear and effectively absorbs rotational fluctuations in the motion of the drive shaft so that they are not transmitted to the driven components. Torsional vibrations of the shaft to which the device is attached are damped by means of an inertia ring connected to the primary element by means of an elastic element. A radial guide friction bearing is disposed between the outside of the inertia ring and the inside of the pulley rim. Relative rotation displacement between the secondary element and the inertia ring is guided radially by the bearing and is damped by the frictional contact provided by the bearing material.

The space available in internal combustion engines is confined and constant attempts are made to make such torque isolation devices more compact without compromising their efficiency. Moreover, as in any manufacturing industry there is always pressure to reduce production costs of devices of this kind by simplifying manufacturing and assembly procedures.

It is an object of the present invention to obviate or mitigate the aforesaid problems and to provide for a device for isolating torque fluctuations that is not only cheaper to produce but has improved performance.

According to the present invention there is provided a device for isolating fluctuations in torque of a rotary drive shaft, the device having an axis of rotation and comprising a first member for connection to the drive shaft, a second member for connection to a driven member, a first resilient member interposed between and connected to the first and second members, the first member being connected to an inertia member via a second resilient member, a radial clearance defined between at least part of the second member and the inertia member, and a bearing disposed in said clearance characterised in that the bearing comprises a first portion that serves as a radial journal bearing and a second portion that serves as an axial thrust bearing, the bearing permitting relative movement of the first and second portions with friction.

The provision of a single bearing in the radial clearance to perform both as a radial journal bearing and an axial thrust bearing results in a device that has fewer components. Not only does it reduce the number of bearings but it also enables a reduction in the number of other components in the device. This means that the device is simpler and cheaper to manufacture and assemble. In addition the device is more compact and provides for improved rotational and translational guidance for the second member.

The radial clearance preferably has a first portion that extends substantially in parallel to the axis of rotation of the device and a second portion that extends in a direction divergent from the axis of rotation, the bearing being received in the clearance such that the first portion of the bearing is received in the first portion of the clearance and the second portion of the bearing is received in the second portion of the clearance.

The second portions of the bearing and the clearance are preferably substantially frustoconical in configuration.

The inertia member may have a radially outer surface on which the bearing is supported, the outer surface of the inertia member having a first portion extending axially and a second portion that projects in a direction divergent from the axis of rotation.

The second member ideally comprises an axially extending rim, the inner surface of which is complementary to the outer surface of the inertia member, the bearing being supported between said inner surface of the rim and the outer surface of the inertia member. The outer surface of the rim is preferably contoured to accept a transmission belt for driving the driven components.

The first resilient member is preferably disposed in an axial spacing between radial flanges on said first and second members.

The first member preferably comprises a hub member to which the first resilient member is connected and a support member on which the inertia member is mounted. The second resilient member may be disposed between the inertia member and an axial wall of the support member. The support member may have a substantially radial wall that is connected to said hub member.

The rim of the second member preferably defines a wall of a peripheral annular channel in which inertia member is received. The channel may be defined entirely by the second member or, alternatively, may be defined between the rim of the second member and the first resilient member.

The first member preferably has a plurality of apertures in radial portion thereof to permit injection of material for the first resilient member during construction.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a sectioned view along a diameter of a first embodiment of a torque isolating device of the present invention; and

Figure 2 is a sectioned view through a diameter of a second embodiment of half a torque isolating device of the present invention (the other half being a mirror image of that shown);

Referring now to figure 1, the device 1 comprises concentric metal hub and pulley members 2, 3 that are interconnected by an annular elastomeric member 4.

The hub member 2 is designed to be mounted in fixed engagement on a rotary drive shaft (not shown) such as, for example, the crankshaft of an internal combustion engine of a motor vehicle. The pulley member 3 is designed to receive a transmission belt (not shown) that drivingly connects it to one or more driven auxiliary components such as an alternator, a fan or other piece of equipment so that the engine can drive the driven equipment.

The hub member 2 comprises a stepped cylinder 10 having an axially extending portion 11 at one end for connection to the drive shaft and a radially outward extending flange 12 at the other end. In between, the cylinder 10 has a radially extending shoulder 13 and main portion 14 that extends substantially axially. The radial flange 12 is dished slightly and has a plurality of equi-angularly spaced apertures 12a the purpose of which will be explained later.

At the outer periphery of the device 1, the pulley member 3 takes the form of an annular channel 15, the radially innermost wall 16 of which has a flange 17 extending generally radially inwards. The outermost wall 18 of the channel 15 defines a pulley rim that extends in a direction substantially parallel to the rotational axis R of the drive shaft. The radial outer surface of the pulley rim 18 has a V-groove configuration 19 designed to receive a drive belt having a complementary V-groove configuration. The drive belt is used to drive auxiliary equipment as described above. The inwardly extending flange 17 of the pulley member 3 is radially contiguous with, but axially spaced from, the flange 12 on the hub member 2 so as to define an axial spacing in which the elastomeric member 4 is received. The elastomeric member 4 is bonded to the metal of the hub and pulley members 2, 3 by known bonding technology.

An annular inertia member 20 is received in the channel 16 of the pulley member 3 such that one of its side faces 21 is exposed. Such a member 20 is well known and serves to dampen torsional vibrations of the drive shaft. A dish-shaped disc 22 connected to the hub member 2 supports the inertia member 20 in the channel. The disc 22 has a central aperture 23 in which the axially extending end portion 11 of the hub member 2 is received and is welded to the radial shoulder 13 of the hub member 2 in the region around the central aperture 23. At its periphery the disc 22 has an axial wall 24 that extends into the channel 16 and provides a radial support for the annular inertial member 20. An elastomeric damping ring 25 is interposed between the inertia member 20 and the axial wall 24.

The inertia member 20 has an integral radially projecting rib 26 adjacent to its exposed face 21. The pulley rim 18 extends over the radially outer surface of the inertia member 20 with a radial clearance 27 and the rib 26 is accommodated in a complementary recess 28 defined on its inside surface. The radial clearance 27 thus has a first portion 27a of substantially constant diameter and a second portion 27b, between the rib 26 and recess 28, of increasing diameter forming a frusto-conical section. A bearing 29 such as, for example, PTFE or nylon tape occupies both portions of the clearance 27. The part of the bearing 29 that occupies the first portion 27a of the clearance 27 acts as a radial journal bearing for the pulley rim 18 whereas that part which occupies the frusto-conical section 27b of the clearance 27 (i.e. disposed between the rib 26 and the recess 28) acts as an axial thrust bearing.

When in use, the drive shaft applies a torque to the hub member 2 and therefore the disc 22. The torque is transferred from the hub member 2 to the pulley member 3 via the elastomeric member 4. The elastomeric member 4 disposed between the hub and pulley members 2, 3 has torsional flexibility. It isolates the cyclic torque fluctuations of the drive shaft and prevents their transmission to the pulley member 3 (and therefore the auxiliary equipment and the belt).

The bearing 29 is of a pre-determined low friction so that relative rotation of the hub member 2 and the pulley member 3 is permitted but occurs with sufficient friction to provide additional damping of vibrations. The bearing 29 provides for improved rotational and axial guidance of the pulley member 3 relative to the hub member 2. The location of the axial thrust portion of the bearing 29 at the outer periphery of the device 1 reduces the possibility of any adverse effect that may be caused in the event that the pulley member 3 becomes loose (owing for example to slack in the bearing 29) and tends move out of concentric alignment with the rest of the device 1.

The physical characteristics of the inertia member 20 and the bearing 29 are selected according to the degree of damping required for a particular combination of drive shaft and driven member.

In the embodiment of figure 1 the elastomeric member 4 between the hub and pulley flanges 12, 17 is loaded in compression by virtue of the flange 17 on the pulley member 3 being axially in-board of the flange 12 on the hub member 2. This arrangement results in greater durability of the elastomeric material.

The above-described arrangement provides for a device with fewer components in comparison to conventional design such as that described in EP EP808431. The provision of the combined axial thrust and radial journal bearing in the clearance between the inertia member and the pulley rim eliminates the requirement for a separate axial bearing. Such a bearing is conventionally located radially in-board of the inertia member 20 and is mounted between radial flanges (one connected to or integral with the hub member and one connected to or integral with the pulley member). This means that an additional radial flange connected to the hub member is required to provide a surface to which the elastomeric member is bonded. Thus with one less bearing and flange (and therefore one less welding or bonding operation to connect such a flange) the device of the present invention is cheaper to manufacture and assemble in comparison to prior designs

The provision of the apertures 13 in the radial flange 12 of the hub member 2 and the absence of an axial bearing in that region allows relatively simple joining of the hub member 2 to the pulley member 3. The material of the elastomeric member 4 is simply injected directly through the apertures 13 with the hub and pulley members in place and then left to cure. Thereafter assembly of the device is completed by insertion of the pre-assembled combination of the inertia member 20, bearing 29, elastomeric ring 25 and the disc 22 and welding of the disc 22 to the shoulder 13 of the hub member 2.

An alternative embodiment of the present invention is shown in figure 2 in which parts corresponding to those shown in figure 1 are indicated with the same reference numeral but increased by 100 and are not further described except insofar as they differ from their counterparts in figure 1. In this embodiment, the elastomeric member 104 is loaded in tension. The only significant different in the structure is the configuration of the pulley member 103 and the hub member 102. Instead of a channel portion the pulley member 103 comprises the rim 118 and an approximately radially inward extending flange 140. The hub member 102 is again in the form of a cylinder but is considerably shorter in length in comparison to that in the embodiment of figure 1. Thus the radial flange 141 of the hub member 102 and corresponding flange 140 of the pulley member 103 (between which the elastomeric member 104 is bonded) are axially reversed in comparison to the design of figure 1.

It will be understood that numerous modifications to the above described designs may be made without departing from the scope of the invention as defined in the appended claims. For example, the first annular member may be fitted to the rotary drive shaft by any suitable means such as a key, spline or shrink connection. The low friction bearings may be manufactured from any suitable material such as, for example, sintered bronze impregnated with PTFE. Additional mechanical drive components may be provided to ensure that the rotational drive is still effective in the event that the elastomeric member fails. Alternative embodiments of the surface of the pulley rim may be provided (not shown) for example chain sprockets to receive a chain drive.

CLAIMS

1. A device for isolating fluctuations in torque of a rotary drive shaft, the device having an axis of rotation and comprising a first member for connection to the drive shaft, a second member for connection to a driven member, a first resilient member interposed between and connected to the first and second members, the first member being connected to an inertia member via a second resilient member, a radial clearance defined between at least part of the second member and the inertia member, and a bearing disposed in said clearance characterised in that the bearing comprises a first portion that serves as a radial journal bearing and a second portion that serves as an axial thrust bearing, the bearing permitting relative rotation of the first and second member with friction.

2. A device according to claim 1, wherein the radial clearance has a first portion that extends substantially in parallel to the axis of rotation of the device and a second portion that extends in a direction divergent from the axis of rotation, the bearing being received in the clearance such that the first portion of the bearing is received in the first portion of the clearance and the second portion of the bearing is received in the second portion of the clearance.

3. A device according to claim 1 or 2, wherein the second portions of the bearing and the clearance are substantially frustoconical in configuration.

4. A device according to claim 1, 2 or 3, wherein the inertia member has a radially outer surface on which the bearing is supported, the outer surface of the inertia member having a first portion extending axially and a second portion that projects in a direction divergent from the axis of rotation.

5. A device according to any preceding claim, wherein the second member comprises an axially extending rim, the inner surface of which is complementary to the outer surface of the inertia member, the bearing being supported between said inner surface of the rim and the outer surface of the inertia member.

6. A device according to any preceding claim, the outer surface of the rim being contoured to accept a transmission belt for driving the driven components.

7. A device according to any preceding claim, wherein the first resilient member is disposed in axial spacing between radial flanges on said first and second members.

8. A device according to any preceding claim, wherein the first member comprises a hub member to which the first resilient member is connected and a support member on which the inertia member is mounted.

9. A device according to claim 8, wherein the second resilient member is disposed between the inertia member and an axial wall of the support member.

10. A device according to claim 8 or 9, wherein the support member has a substantially radial wall that is connected to said hub member.

11. A device according to claim 5, wherein the rim of the second member defines a wall of a peripheral annular channel in which inertia member is received.

12. A device according to claim 11, wherein the channel is defined entirely by the second member.

13. A device according to claim 11, wherein the channel is defined between the rim of the second member and the first resilient member.

14. A device according to any preceding claim, wherein the first member has a plurality of apertures in radial portion thereof to permit injection of material for the first resilient member during construction of the device.

15. A drive assembly comprising a rotary drive shaft connected to a driven member via a device according to any preceding claim.

16. A device for isolating fluctuations in torque substantially as hereinbefore described with reference to the accompanying drawings.

17. A drive assembly substantially as hereinbefore described with reference to the accompanying drawings.

Application No:	GB 0127982.7	**Examiner:**	Kevin Hewitt
Claims searched:	1-17	**Date of search:**	29 October 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): F2S (SCK); F2U

Int Cl (Ed.7): F16D 3/50; F16F 15/124, 15/126, 15/129; F16H 55/14, 55/36

Other: Online WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0808431 A1	(HOLSET ENGINEERING) See in particular Fig. 1	-
A	US 5449322 A	(WAGNER) See in particular sliding bush 6 in Fig. 2.	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		